FIG.1

HOST
COMPUTER

SRAM — 23

21
CONTROLLER
LSI

24
OSC

CPU — 22

FLASH — 25-1

FLASH — 25-2

FLASH — 25-3

FLASH — 25-4
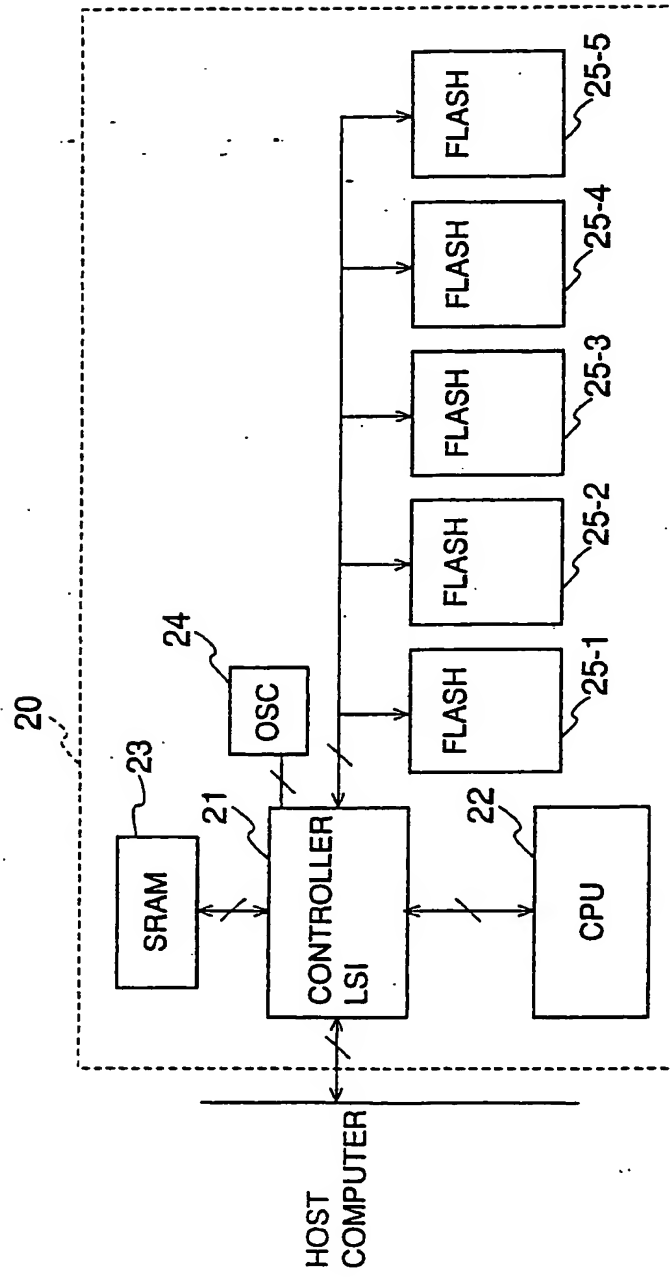
FLASH — 25-5

20

FIG.2

23

TABLE FOR ERASING TIMES	→	NUMBER OF ERASURES FOR EACH BLOCK
TABLE FOR NUMBER OF ERASABLE SECTORS	→	NUMBER OF ERASE FLAGS FOR EACH BLOCK
WRITE POINTER	→	CHIP NO., BLOCK NO., SECTOR ADDRESS NO.TO WRITE DATA
WORK - BLOCK - NO.	→	CHIP NO., BLOCK NO.OF CURRENT WORK BLOCK
CLEANING UP POINTER	→	CHIP NO., BLOCK NO., SECTOR ADDRESS NO.OF PLACE BEING CLEANED UP
REWRITE FLAG	→	DATA TO BE WRITTEN BRAND-NEW OR REWRITE?
NUMBER OF WRITING TIMES	→	NUMBER OF WRITING TIMES DURING TIME OF CLEANING UP
EVACUATION COUNTER	→	NUMBER OF SECTORS EVACUATED AT TIME OF CLEANING UP
NUMBER OF CHIPS	→	NUMBER OF FLASH CHIPS IN MEMORY CARD
SECTOR MAP TABLE	→	TABLE FOR LOGICAL ADDRESS CONVERSION

FIG.3

INDICATING DEFECTIVE SECTOR OR NOT

INDICATING OBSOLETE DATA OR NOT

LOGICAL ADDRESS OF THIS SECTOR

DATA OF THIS SECTOR

CHECK SUM OF DATA

126 SECTOR

25-1

1 SECTOR

| DEFECT FLAG | ERASE FLAG | LOGICAL ADDRESS | DATA | CHECK SUM | DEFECT FLAG | ERASE FLAG | LOGICAL ADDRESS | DATA | CHECK SUM | DEFECT FLAG |

FIG.4

CHECK SUM	
DEFECTIVE SECTOR MEMORY	→ SHOWING DEFECTIVE SECTORS OF BLOCK BEING CLEANED UP
CLEANING UP TARGET BLOCK ERASING TIMES	→ NUMBER OF ERASURES AT TIME OF CLEANING UP OF BLOCK BEING CLEANED UP
ERASING TEIMES	→ NUMBER OF ERASURES
EVACUATION BLOCK NO.	→ CHIP NO. AND BLOCK NO. OF BLOCK EVACUATED TO THIS BLOCK
START ERASING	→ MARKED AT BEGINNING OF ERASING BLOCK BEING CLEANED UP
END ERASING	→ MARKED AT END OF ERASING BLOCK BEING CLEANED UP
ALL ERASE TARGET	→ MARKED WHEN THIS BLOCK IS TARGET OF "ALL ERASE"
FREE BLOCK	→ MARKED WHEN THERE IS DATA IN BLOCK
BLOCK STATUS	→ MARKED WHEN BLOCK BECOMES DEFECTIVE

25-1

FIG.5

WRITING DATA

SETTING REWRITE FLAG TO ZERO | S1

S2
CLEANING UP UNDERWAY? — NO →

YES

ADDING 1 TO NUMBER OF WRITING TIMES | S3

SETTING NUMBER OF WRITING TIMES TO ZERO | S5

S4
NUMBER OF WRITING TIMES EQUAL TO 6? — NO →

YES

SETTING NUMBER OF WRITING TIMES TO 1 | S6

S7
LOGICAL ADDRESS EXCEEDING LIMIT? — YES → ERROR HANDLING

NO

S8
OLD DATA TO BE REPLACED? — NO →

YES

SETTING REWRITE FLAG TO 1 | S9

SETTING REWRITE FLAG TO ZERO | S10

TRANSFERRING DATA FROM HOST COMPUTER TO SRAM | S11

S12
ERROR IN TRANSFER? — YES → ERROR HANDLING

NO

①

FIG.6

(1)

S13

REWRITE FLAG EQUAL TO ZERO? — YES

NO

PUTTING UP ERASE FLAG AT SECTORS OF OLD DATA | S14

S15

NUMBER OF WRITING TIMES EQUAL TO 1? — NO

YES

SETTING EVACUATION COUNTER TO ZERO | S16

S17

CLEANING UP POINTER SMALLER THAN 126 — NO

YES

S18

CLEANING UP POINTER EQUAL TO ZERO ? — NO

YES

SELECTING TARGET OF CLEANING UP BASED ON NUMBER OF ERASURES AND NUMBER OF ERASABLE SECTORS OF EACH BLOCK | S19

WRITING CHIP NO. AND BLOCK NO. OF TARGET OF CLEANING UP INTO EVACUATION BLOCK NO. OF WORK BLOCK | S20

S21

ERROR IN WRITING? — YES → ERROR HANDLING

NO

SEARCH FOR DATA TO BE EVACUATED
ERASE FLAG PUT UP: GOING TO NEXT SECTOR
NO LOGICAL ADDRESS:
   PUTTING UP ERASE FLAG TO CURRENT
   SECTOR, THEN, GOING TO NEXT SECTOR
ANOMALOUS LOGICAL ADDRESS:
   PUTTING UP ERASE FLAG AND DEFECT
   FLAG, AND GOING TO NEXT SECTOR | S22

(2) (3) (4)(5)

FIG.7

S23 ERROR IN WRITING? — YES → ERROR HANDLING

NO

S24 CLEANING UP POINTER INDICATING 126TH SECTOR? — YES →

NO

S25 MOVING DATA TO BE EVACUATED FROM FLASH MEMORY TO SRAM 23

S26 GENERATED CHECK SUM EQUAL TO CHECK SUM? — YES →

NO

S27 CHECK SUM EQUAL TO FFh? — YES →

NO

S28 SETTING CHECK SUM TO FFh, AND PUTTING UP DEFECT FLAG AT SECTORS OF EVACUATED DATA

S29 ERROR IN WRITING? — YES → ERROR HANDLING

NO

S30 SEARCHING WRITE-ENABLE SECTOR BY STARTING FROM SECTOR INDICATED BY WRITE POINTER

S31 WRITE-ENABLE SECTOR FOUND? — NO → ERROR HANDLING

YES

S32 MOVING DATA STORED IN SRAM TO FLASH MEMORY

S33 ERROR IN WRITING? — YES

NO

(2) (3) (4) (5) (6)

FIG.8

② ⑥ ④ ⑤

| PUTTING UP ERASE FLAG AT SECTOR OF EVACUATED DATA | S34 |

S35
ERROR IN WRITING? ——YES——→ ERROR HANDLING
NO

| UPDATING SECTOR MAP TABLE, AND ADDING 1 TO EVACUATION COUNTER | S36 |

S37
NO←— EVACUATION COUNTER EQUAL TO 60?
YES

S38
EVACUATION COUNTER EQUAL TO ZERO? ——YES——→
NO

| WRITING INFORMATION ON DEFECT FLAGS OF EVACUATED BLOCK INTO DEFECT SECTOR MEMORY, AND ERASING TIMES INTO CLEANING UP TARGET BLOCK ERASING TIMES (WRITING IN WORK BLOCK) | S39 |

S40
ERROR IN WRITING? ——YES——→ ERROR HANDLING
NO

| ERASING CLEANED UP BLOCK | S41 |

S42
ERROR IN ERASING? ——YES——→ ERROR HANDLING
NO

⑦ ⑤

FIG.9

```
        (7)                                              (5)
         │                                                │
┌────────────────────────────────────────────────┐       │
│ WRITING INFORMATION ON DEFECT FLAGS IN DEFECTIVE │ S43  │
│ SECTOR MEMORY BACK TO ERASED BLOCK, AND WRITING  │      │
│ CLEANING UP TARGET BLOCK ERASING TIMES PLUS ONE  │      │
│ INTO ERASING TIMES AT ERASED BLOCK               │      │
└────────────────────────────────────────────────┘       │
         │                                                │
┌────────────────────────────────────────────────┐       │
│ ADDING 1 TO NUMBER OF ERASURES OF ERASED BLOCK IN│ S44  │
│ TABLE FOR ERASING TIMES, AND SETTING NUMBER OF   │      │
│ ERASABLE SECTORS TO ZERO IN TABLE FOR NUMBER OF  │      │
│ ERASABLE SECTORS                                 │      │
└────────────────────────────────────────────────┘       │
         │                                                │
┌────────────────────────────────────────────────┐       │
│ COPYING CLEANING UP POINTER TO WORK BLOCK NO.,   │ S45  │
│ AND SETTING CLEANING UP POINTER TO ZERO          │      │
└────────────────────────────────────────────────┘       │
         │────────────────────────────────────────────────┘
┌────────────────────────────────────────────────┐
│ STARTING SEARCH FOR WRITE-ENABLE SECTOR FROM     │ S46
│ SECTOR INDICATED BY WRITE POINTER                │
└────────────────────────────────────────────────┘
```

S47 WRITE-ENABLE SECTOR FOUND? — NO → ERROR HANDLING

YES

S48 MOVING DATA IN SRAM TO FLASH MEMORY

S49 ERROR IN WRITING? — YES

NO

S50 REWRITE FLAG EQUAL TO 1? — NO

YES

S51 ADDING 1 TO NUMBER IN TABLE FOR NUMBER OF ERASABLE SECTORS FOR EACH SECTOR WITH ERASE FLAG WRITTEN

S52 UPDATING SECTOR MAP TABLE

S53 STARTING SEARCH FOR WRITE-ENABLE SECTOR FROM SECTOR INDICATED BY WRITE POINTER

END

FIG.10A

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
A	G				
B	H				
C	I				
D					
E					
F					

FIG.10B

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
A	G				
B	H				
ERASABLE	I				
ERASABLE	C				
E	D				
F					

FIG.10C

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
A	G	K			
B	H	L			
ERASABLE	I	M			
ERASABLE	C	N			
E	D	O			
F	J				

FIG.10D

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
A	G	ERASABLE	I		
B	ERASABLE	ERASABLE	J		
ERASABLE	ERASABLE	ERASABLE	K		
ERASABLE	C	ERASABLE	L		
E	D	O	M		
F	ERASABLE	H	N		

FIG.10E

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
A	G			O	H
B	ERASABLE			I	J
ERASABLE	ERASABLE			K	L
ERASABLE	C			M	N
E	D				
F	ERASABLE				

FIG.10F

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
A	G			O	H
B	ERASABLE			I	J
ERASABLE	ERASABLE			K	L
ERASABLE	ERASABLE			M	N
E	ERASABLE			C	
F	ERASABLE			D	

FIG.10G

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
A	G			O	ERASABLE
B	ERASABLE			ERASABLE	J
ERASABLE	ERASABLE			K	L
ERASABLE	ERASABLE			M	N
E	ERASABLE			C	H
F	ERASABLE			D	I

FIG.10H

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
A		G	J	O	
B		L	N	ERASABLE	
ERASABLE		H	I	K	
ERASABLE				M	
E				C	
F				D	

FIG.10I

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
A		G	ERASABLE	O	
B		L	N	ERASABLE	
ERASABLE		H	I	K	
ERASABLE		J		M	
E				C	
F				D	

FIG.10J

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
A		ERASABLE	ERASABLE	O	
B		L	N	ERASABLE	
ERASABLE		H	I	K	
ERASABLE		J	G	M	
ERASABLE		E		C	
ERASABLE		F		D	

FIG.11

WRITING METHOD

RECEIVING DATA FROM HOST COMPUTER — S1

NUMBER OF BLOCKS HAVING FREE SECTORS LESS THAN N? — S2 — NO

YES

SELECTING m BLOCKS AS EVACUEE IN DESCENDING ORDER OF NUMBER OF ERASABLE SECTORS — S3

SELECTING n BLOCKS AS EVACUEE IN ASCENDING ORDER OF NUMBER OF ERASABLE SECTORS — S4

MOVING DATA IN EVACUEE BLOCK TO FREE BLOCK WITH DIFFERENT BLOCK SELECTED AS DESTINATION BLOCK, M BLOCK FORMING ONE ROTATION — S5

ERASING EVACUATED BLOCK — S6

PUTTING UP ERASE FLAG AT PHYSICAL SECTOR WITH LOGICAL SECTOR IDENTICAL TO THAT OF DATA TO BE WRITTEN — S7

WRITING DATA INTO FLASH MEMORY — S8

END

FIG.12A

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
A ⇒	G				
B					
C					
D					
E					
F					

(EVACUATION AREA)

FIG.12B

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
ERASABLE	ERASABLE ⇒				
B	A				
C	D				
ERASABLE	E				
ERASABLE	F				
ERASABLE	G				

(EVACUATION AREA)

FIG.12C

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
ERASABLE	ERASABLE	H	N		
B	A	I ⇒			
C	D	J			
ERASABLE	E	K			
ERASABLE	F	L			
ERASABLE	G	M			

(EVACUATION AREA)

FIG.12D

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
ERASABLE	ERASABLE	ERASABLE	N	K	
B	ERASABLE	ERASABLE	A	L	
C	D	ERASABLE	G ⇨		
ERASABLE	E	ERASABLE	H		
ERASABLE	F	ERASABLE	I		
ERASABLE	ERASABLE	M	J		

(EVACUATION AREA)

FIG.12E

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
ERASABLE	ERASABLE	ERASABLE	N	K ⇨	
B	ERASABLE	ERASABLE	ERASABLE	L	
C	D	ERASABLE	G	A	
ERASABLE	E	ERASABLE	ERASABLE	H	
ERASABLE	F	ERASABLE	ERASABLE	I	
ERASABLE	ERASABLE	M	ERASABLE	J	

(EVACUATION AREA)

FIG.12F

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
ERASABLE	ERASABLE		N	K	M
B	ERASABLE		ERASABLE	L ⇨	
C	D		G	A	
ERASABLE	E		ERASABLE	H	
ERASABLE	F		ERASABLE	I	
ERASABLE	ERASABLE		ERASABLE	J	

(EVACUATION AREA)

FIG.12G

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
ERASABLE	ERASABLE ⇒		N	ERASABLE	M
B	ERASABLE		ERASABLE	ERASABLE	A
C	D		G	ERASABLE	I
ERASABLE	E		ERASABLE	H	J
ERASABLE	F		ERASABLE	ERASABLE	K
ERASABLE	ERASABLE		ERASABLE	ERASABLE	L

(EVACUATION AREA)

FIG.12H

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
ERASABLE		D	N	ERASABLE	M
B		E	ERASABLE	ERASABLE	A
C		F	G	ERASABLE	I
ERASABLE	⇒		ERASABLE	H	J
ERASABLE			ERASABLE	ERASABLE	K
ERASABLE			ERASABLE	ERASABLE	L

(EVACUATION AREA)

FIG.12I

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
	B	D	N	ERASABLE	M
	C	E	ERASABLE	ERASABLE	A
⇒		F	G	ERASABLE	I
			ERASABLE	H	J
			ERASABLE	ERASABLE	K
			ERASABLE	ERASABLE	L

(EVACUATION AREA)

FIG.12J

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
H	B	D	N		M
	C	E	ERASABLE		A
		F	G		I
			ERASABLE		J
			ERASABLE		K
			ERASABLE		L

(EVACUATION AREA)

FIG.12K

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
H	B	D		N	M
	C	E		G	A
		F			I
					J
					K
					L

(EVACUATION AREA)

FIG.12L

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
ERASABLE	B	D		N	M
	C	E		G	A
		F		A	ERASABLE
				H	ERASABLE
				I	K
				J	L

(EVACUATION AREA)

FIG.13

```
┌─────────────────────────────────┐
│   EVACUATION PROCESSING METHOD   │
└─────────────────────────────────┘
                  │
┌─────────────────────────────────────────┐
│ STORING BLOCK NO. OF CURRENT EVACUATION   │ S1
│ AREA IN MEMORY                            │
└─────────────────────────────────────────┘
                  │
┌─────────────────────────────────────────┐
│ POINTING CURRENT EVACUATION AREA AS TARGET│ S2
└─────────────────────────────────────────┘
                  │
                  ▼
┌─────────────────────────────────────────┐
│ SHIFTING TARGET BACKWARD BY ONE BLOCK IN  │ S3
│ WRITING DIRECTION                         │
└─────────────────────────────────────────┘
                  │
             ◇ S4
        TARGET BLOCK
   EQUAL TO BLOCK NO. STORED IN ──── YES
        MEMORY?
                  │ NO
             ◇ S5
          NUMBER OF
NO ──── ERASABLE SECTORS GREATER
        THAN m
                  │ YES
┌─────────────────────────────────────────┐
│ SELECTING TARGET AS EVACUEE               │ S6
└─────────────────────────────────────────┘
                  │
┌─────────────────────────────────────────┐
│ MOVING WRITE POINTER TO FIRST SECTOR OF   │ S7
│ EVACUATION AREA                           │
└─────────────────────────────────────────┘
                  │
┌─────────────────────────────────────────┐
│ MOVING DATA OF EVACUEE TO EVACUATION AREA │ S8
└─────────────────────────────────────────┘
                  │
┌─────────────────────────────────────────┐
│ ERASING EVACUEE BLOCK                     │ S9
└─────────────────────────────────────────┘
                  │
┌─────────────────────────────────────────┐
│ ASSIGNING EVACUEE BLOCK TO EVACUATION AREA│ S10
└─────────────────────────────────────────┘
                  │
┌─────────────────────────────────────────┐
│                  END                      │
└─────────────────────────────────────────┘
```

FIG.14A

BLOCK0	BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
	A	G				
	B					
	C					
	D					
	E					
	F					

(BACKUP AREA) (EVACUATION AREA)

FIG.14B

BLOCK0	BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
	ERASABLE	ERASABLE				
	B	A				
	C	D				
	ERASABLE	E				
	ERASABLE	F				
	ERASABLE	G				

(BACKUP AREA) (EVACUATION AREA)

FIG.14C

BLOCK0	BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
	ERASABLE	ERASABLE	H	N		
	B	A	I			
	C	D	J			
	ERASABLE	E	K			
	ERASABLE	F	L			
	ERASABLE	G	M			

(BACKUP AREA) (EVACUATION AREA)

FIG.14D

BLOCK0	BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
	ERASABLE	ERASABLE	ERASABLE	N	K	
	B	ERASABLE	ERASABLE	A	L	
	C	D	ERASABLE	G		
	ERASABLE	E	ERASABLE	H		
	ERASABLE	F	ERASABLE	I		
	ERASABLE	G	M	J		
(BACKUP AREA)						(EVACUATION AREA)

FIG.14E

BLOCK0	BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
	ERASABLE	ERASABLE	ERASABLE	N	K	
	B	ERASABLE	ERASABLE	ERASABLE	L	
	C	D	ERASABLE	G	A	
	ERASABLE	E	ERASABLE	ERASABLE	H	
	ERASABLE	F	ERASABLE	ERASABLE	I	
	ERASABLE	ERASABLE	M	ERASABLE	J	
(BACKUP AREA)						(EVACUATION AREA)

FIG.14F

BLOCK0	BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
	ERASABLE	ERASABLE		N	K	M
	B	ERASABLE		ERASABLE	L	
	C	D		G	A	
	ERASABLE	E		ERASABLE	H	
	ERASABLE	F		ERASABLE	I	
	ERASABLE	ERASABLE		ERASABLE	J	
(BACKUP AREA)			(EVACUATION AREA)			

FIG.14G

BLOCK0	BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
	ERASABLE	ERASABLE		N	ERASABLE	M
	B	ERASABLE		ERASABLE	ERASABLE	A
	C	D		G	ERASABLE	I
	ERASABLE	E		ERASABLE	H	J
	ERASABLE	F		ERASABLE	ERASABLE	K
	ERASABLE	ERASABLE		ERASABLE	ERASABLE	L
(BACKUP AREA)			(EVACUATION AREA)			

FIG.14H

BLOCK0	BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
	ERASABLE	ERASABLE	H	N		M
	B	ERASABLE		ERASABLE		A
	C	D		G		I
	ERASABLE	E		ERASABLE		J
	ERASABLE	F		ERASABLE		K
	ERASABLE	ERASABLE		ERASABLE		L
(BACKUP AREA)				(EVACUATION AREA)		

FIG.14I

BLOCK0	BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
B		ERASABLE	H	N		M
C		ERASABLE		ERASABLE		A
		D		G		I
		E		ERASABLE		J
		F		ERASABLE		K
		ERASABLE		ERASABLE		L
(BACKUP AREA)	(EVACUATION AREA)				(UNABLE TO BE USED)	

FIG.14J

BLOCK0	BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
		ERASABLE	H	N		M
		ERASABLE	B	ERASABLE		A
		D	C	G		I
		E		ERASABLE		J
		F		ERASABLE		K
		ERASABLE		ERASABLE		L
(BACKUP AREA)	(EVACUATION AREA)				(UNABLE TO BE USED)	

FIG.14K

BLOCK0	BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
		ERASABLE	H	ERASABLE		ERASABLE
		ERASABLE	B	ERASABLE		ERASABLE
		D	C	G		I
		E	A	ERASABLE		J
		F	M	ERASABLE		K
		ERASABLE	N	ERASABLE		L
(BACKUP AREA)	(EVACUATION AREA)				(UNABLE TO BE USED)	

FIG.14L

BLOCK0	BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
	G	ERASABLE	H			ERASABLE
		ERASABLE	B			ERASABLE
		D	C			I
		E	A			J
		F	M			K
		ERASABLE	N			L
(BACKUP AREA)				(EVACUATION AREA)	(UNABLE TO BE USED)	

FIG.14M

BLOCK0	BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
	ERASABLE	ERASABLE	ERASABLE			ERASABLE
	A	ERASABLE	B			ERASABLE
	G	D	C			I
	H	E	ERASABLE			J
	O	F	M			K
	P	ERASABLE	N			L
(BACKUP AREA)				(EVACUATION AREA)	(UNABLE TO BE USED)	

FIG.14N

BLOCK0	BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
	ERASABLE		ERASABLE	D		ERASABLE
	A		B	E		ERASABLE
	G		C	F		I
	H		ERASABLE			J
	O		M			K
	P		N			L
(BACKUP AREA)		(EVACUATION AREA)			(UNABLE TO BE USED)	

FIG.14O

BLOCK0	BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
B	ERASABLE			D		ERASABLE
C	A			E		ERASABLE
M	G			F		I
N	H					J
	O					K
	P					L
(BACKUP AREA)		(UNABLE TO BE USED)	(EVACUATION AREA)		(UNABLE TO BE USED)	

FIG.14P

BLOCK0	BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
B	ERASABLE		K	D		
C	A		L	E		
M	G			F		
N	H					
I	O					
J	P					
(BACKUP AREA)		(UNABLE TO BE USED)			(UNABLE TO BE USED)	(EVACUATION AREA)

FIG.14Q

BLOCK0	BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
ERASABLE	ERASABLE		K	D		
ERASABLE	A		L	E		
ERASABLE	G		B	F		
ERASABLE	H		C			
	O		M			
	P		N			
(BACKUP AREA)		(UNABLE TO BE USED)			(UNABLE TO BE USED)	(EVACUATION AREA)

FIG.14R

BLOCK0	BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
	ERASABLE		K	D		
	A		L	E		
	G		B	F		
	H		C	I		
	O		M	J		
	P		N			
(BACKUP AREA)		(UNABLE TO BE USED)			(UNABLE TO BE USED)	(EVACUATION AREA)

FIG.15

AREA PROCESSING METHOD

S1 — ERASABLE SECTORS IN BACKUP AREA? —— YES

NO

LOCATING WRITE POINTER AT FIRST SECTOR OF BACKUP AREA | S2

S3 — DATA IN BACKUP AREA? —— YES

NO

ASSIGNING BACKUP AREA TO EVACUATION AREA | S4

S5 — NO ERASABLE SECTOR? —— NO → ABORT

YES

SELECTING BLOCK WITH LARGEST NUMBER OF ERASABLE SECTORS AS EVACUEE | S6

MOVING DATA | S7

ERASING EVACUEE BLOCK | S8

ASSIGNING EVACUEE BLOCK TO EVACUATION AREA | S9

S10 — NUMBER OF DATA IN BACKUP AREA LARGER THAN NUMBER OF FREE SECTORS OUTSIDE EVACUATION AREA

YES

NO

STARTING SEARCH FOR FREE SECTOR BY USING WRITE FLAG FROM NEXT SECTOR OF EVACUATION AREA | S11

MOVING DATA IN BACKUP AREA TO FREE SECTOR | S12

ERASING BACKUP AREA | S13

END

FIG.16A

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
ON	ON		ON		

WRITE FLAG

EXECUTING FLAG

FIG.16B

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
ON	ON		ON		
					ON

WRITE FLAG

EXECUTING FLAG

FIG.16C

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
	ON		ON		
					ON

WRITE FLAG

EXECUTING FLAG

FIG.16D

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6

ON

WRITE FLAG

EXECUTING
FLAG

ON

FIG.16E

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6

WRITE FLAG

EXECUTING
FLAG

ON

FIG.16F

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6

WRITE FLAG

EXECUTING
FLAG

FIG.17

```
            ┌─────────────────────────┐
            │     ERASING METHOD      │
            └─────────────────────────┘
                        │
                        │           S1
              ◇─────────────────────────◇  YES
             ╱  EXECUTING FLAG IN EXISTENCE? ╲─────────┐
              ◇─────────────────────────◇            │
                        │ NO                          │
            ┌─────────────────────────────────┐  S2   │
            │ WRITING EXECUTING FLAG INTO LAST BLOCK │  │
            │ TO BE PROCESSED                 │       │
            └─────────────────────────────────┘       │
                        │◄────────────────────────────┘
            ┌─────────────────────────────────┐  S3
            │     CLEARING PROCESS TARGET     │
            └─────────────────────────────────┘
                        │
         ┌─────────────►│
         │              │              S4
         │         ◇─────────────────────◇  NO
         │        ╱   WRITE FLAG          ╲────────┐
         │        ╲ IN PROCESS TARGET BLOCK ╱      │
         │         ◇─────────?───────────◇         │
         │              │ YES                       │
         │  ┌─────────────────────────────┐  S5     │
         │  │  ERASING PROCESS TARGET BLOCK │        │
         │  └─────────────────────────────┘         │
         │              │◄──────────────────────────┘
         │  ┌─────────────────────────────────────┐ S6
         │  │ FORWARDING PROCESS TARGET TO NEXT BLOCK │
         │  └─────────────────────────────────────┘
         │              │
         │              │             S7
         │  YES  ◇─────────────────────────◇
         └──────╱ EXECUTING FLAG IN EXISTENCE? ╲
                 ◇─────────────────────────◇
                        │ NO
                 ┌──────────────┐
                 │     END      │
                 └──────────────┘
```

FIG.18

HOST
COMPUTER

20

23 — SRAM

21 — CONTROLLER
LSI

22 — CPU

26 — EEPROM

25-1 — FLASH

25-5 — FLASH

FIG.19A

FIG.19B

SECTOR 1-A — C

SECTOR 1-A   A
DEFECTIVE

BACKUP 2
BACKUP 3
BACKUP 4

SECTOR 2-A
SECTOR 3-A
SECTOR 4-A

SECTOR 1-B   B
SECTOR 2-B
SECTOR 3-B
SECTOR 4-B

25-I

26

26I

EEPROM

FIG.20A

FIG.20B

PRIMARY MEMORY MEDIA ~231

DATA

SECTOR NO.

261

SECTOR CONVERSION UNIT

DATA BUS

25

SECTOR 1-A ~A

DEFECTIVE

SECTOR 2-A

SECTOR 3-A

SECTOR 4-A

SECTOR 1-A ~C

BACKUP 2

FIG.21A

FIG.21B

SECTOR
CONVERSION
UNIT

261

SECTOR 1～3

SECTOR 4～6

25

DEFECTIVE BLOCK

| SECTOR 1～3A DEFECTIVE |
| SECTOR 1～3B |
| SECTOR 1～3C |
| SECTOR 1～3D |

A

BLOCK 1

| SECTOR 1～3A | ～C |
| SECTOR 1～3B |
| SECTOR 1～3C |
| SECTOR 1～3D |

BLOCK 2

| SECTOR 4～6A | ～B |
| SECTOR 4～6B |
| SECTOR 4～6C |
| SECTOR 4～6D |

BACKUP BLOCK

| BACKUP 2A | ～C |
| BACKUP 2B |
| BACKUP 2C |
| BACKUP 2D |

FIG.22A

FIG.22B

FIG.23A

SECTOR CONVERSION UNIT — 261

SECTOR 1~3

SECTOR 4~6

25

BLOCK 1

| SECTOR 1~3A | ~ A |
| SECTOR 1~3B |
| SECTOR 1~3C |
| SECTOR 1~3D |

BACKUP BLOCK 1

| BACKUP 1A | ~ C |
| BACKUP 1B |
| BACKUP 1C |
| BACKUP 1D |

BLOCK 2

| SECTOR 4~6A | ~ B |
| SECTOR 4~6B |
| SECTOR 4~6C |
| SECTOR 4~6D |

BACKUP BLOCK 2

| BACKUP 2A | ~ C |
| BACKUP 2B |
| BACKUP 2C |
| BACKUP 2D |

FIG.23B

FIG.24A

```
┌─────────────────────────┐
│    REWRITING PROCESS     │
└─────────────────────────┘
              │
              ▼
┌───────────────────────────────────┐  S1
│ REQUEST FROM HOST COMPUTER FOR     │
│ WRITING OF SECTOR DATA             │
└───────────────────────────────────┘
              │
              ▼
┌───────────────────────────────────┐  S2
│ CPU 22 RECOGNIZING FROM MESSAGE    │
│ SENT BY CONTROLLER LSI 21 THAT     │
│ THERE IS REQUEST FOR WRITING       │
│ SECTOR DATA                        │
└───────────────────────────────────┘
              │
              ▼
┌───────────────────────────────────┐  S3
│ CPU 22 READING EEPROM 26 AND       │
│ IDENTIFYING DESTINATION ADDRESS    │
│ OF SECTOR DATA                     │
└───────────────────────────────────┘
              │
              ▼
┌───────────────────────────────────┐  S4
│ CPU 22 ACCESSING FLASH MEMORIES    │
│ 25-1 TO 25-5 TO CHECK IF THERE IS  │
│ SECTOR DATA ALREADY WRITTEN        │
└───────────────────────────────────┘
              │
              ▼           S5
    ◇───────────────────────────◇
NO  │ SECTOR DATA ALREADY WRITTEN? │
  ◄─◇───────────────────────────◇
  │           │ YES
  │           ▼
  │ ┌───────────────────────────────────┐  S6
  │ │ CPU 22 ACCESSING EEPROM 26 TO GET  │
  │ │ DATA INDICATING LOCATION OF        │
  │ │ ANOTHER SECTOR USED FOR WRITING    │
  │ │ SECTOR DATA                        │
  │ └───────────────────────────────────┘
  │           │
  │           ▼
  │ ┌───────────────────────────────────┐  S7
  │ │ ERASING PARTINENT DATA IN FLASH    │
  │ │ MEMORY                             │
  │ └───────────────────────────────────┘
  │           │
  └───────────┤
              ▼
            ( 1 )
```

FIG.24B

①

TRANSFERRING DATA FROM HOST COMPUTER TO SRAM 23, AND WAITING FOR TRANSFER TO END — S8

CPU 22 SENDING MESSAGE OF WRITING SECTOR DATA TO CONTROLLER LSI 21, WHICH THEN WRITES SECTOR DATA FROM SRAM 23 TO FLASH MEMORY — S9

CPU 22 RECEIVING MESSAGE OF COMPLETION OF WRITING SECTOR DATA FROM CONTROLLER LSI 21 — S10

REWRITE DATA IN EEPROM 26 TO CHANGE SECTOR ADDRESS — S13

S11
ERROR IN WRITING? — NO

YES

S12
ALTERNATE SECTOR IN EXISTENCE ? — YES

NO

②

③

FIG.24C

```
                    ( 2 )                                      ( 3 )
                      |                                          |
                      v                                          |
                  _____         S14                     |
                 /  ANY FLASH   \                                |
            ____/ MEMORY IN THE  \____ NO                        |
               \ PROCESS OF      /                               |
                \ BEING ERASED? /          ┌──────────────────┐  |
                 _____/      S15  │ WAITING FOR      │  |
                      |                     │ ERASING TO       │  |
                     YES                    │ FINISH, AND      │  |
                      |                     │ WRITING SECTOR   │  |
                      |                     │ DATA INTO SECTOR │  |
                      |                     │ JUST ERASED      │  |
                      |                     └──────────────────┘  |
                      |                              |            |
                      v                              └────────────┤
            ┌──────────────────────┐ S16                          |
            │ SENDING ERROR        │                              |
            │ MESSAGE TO HOST      │                              |
            │ COMPUTER             │                              |
            └──────────────────────┘                              |
                      |                                           |
                      v                                           |
            ┌──────────────────────┐ S17                          |
            │ HOST COMPUTER        │                              |
            │ SENDING COMMAND FOR  │                              |
            │ TANSFERRING DATA IN  │                              |
            │ FLASH MEMORY TO      │                              |
            │ ANOTHER MEMORY       │                              |
            │ STORAGE AND          │                              |
            │ REWRITING EEPROM 26  │                              |
            └──────────────────────┘                              |
                      |                                           |
                      v                                           |
            ┌──────────────────────┐ S18                          |
            │ MEMORY DEVICE        │                              |
            │ MODIFYING EEPROM 26  │                              |
            │ IN RESPONSE TO       │                              |
            │ COMMAND FROM HOST    │                              |
            │ COMPUTER, MAKING     │                              |
            │ MORE THAN ONE SECTOR │                              |
            │ AVAILABLE FOR ONE    │                              |
            │ LOGICAL SECTOR       │                              |
            └──────────────────────┘                              |
                      |                                           |
                      └───────────────────────────────────────────┘
                      |
                      v
                ┌───────────┐
                │   END     │
                └───────────┘
```

FIG.25A

301

DECODED
ADDRESS OF
SECTOR 0

0000H

0000H

302

DECODED
ADDRESS OF
0000H

5555H

5555H

25

SECTOR 0

FIG.25B

301

DECODED
ADDRESS OF
SECTOR 0

0000H

0000H

302

DECODED
ADDRESS OF
0000H

8888H

8888H

25

SECTOR 0

FIG.25C

301

DECODED
ADDRESS OF
SECTOR 0

2222H

2222H

302

DECODED
ADDRESS OF
2222H

8888H

8888H

25

SECTOR 0

FIG.26

BLOCK1	BLOCK2	BLOCK3	BLOCK4	BLOCK5	BLOCK6
A	G	F	ERASABLE	ERASABLE	
ERASABLE	ERASABLE	H	ERASABLE	K	
ERASABLE	ERASABLE	ERASABLE	N	L	
ERASABLE	C	B	ERASABLE	M	
ERASABLE	D	ERASABLE	I		
ERASABLE	E	ERASABLE	J		

(EVACUATION AREA)

FIG.27

DATA PROCESSING METHOD

SENDING SIZE OF DATA TO BE WRITTEN TO MEMORY DEVICE TO OBTAIN LENGTH OF TIME NECESSARY FOR WRITING — S1

OBTAINING ELECTRIC POWER TO BE CONSUMED FOR WRITING BY MULTIPLYING CONSUMED ELECTRIC POWER PER HOUR WITH LENGTH OF TIME NECESSARY FOR WRITING — S2

S3

AVAILABLE ELECTRIC POWER CARGER THAN ELECTRIC POWER TO BE CONSUMED ? — NO → COUNTER MEASURE

YES

WRITING DATA INTO MEMORY S4

S5

ACTUAL TIME LENGTH TAKEN TO WRITE DATA EXCEEDING ESTIMATE OF TIME LENGTH? — YES → COUNTER MEASURE

NO

S6

NO — WRITING PROCESS FINISHED?

YES

END

FIG.28A

| b7 | b6 | b5 | ///b4/// | b3 | b2 | b1 | ///b0/// |

FIG.28B

b0 ———\
b4 ———| ⟩——— FLAG STATUS\
bx ------/

FIG.28C

	b4	b0	OUTPUT
1	0	0	0
2	0	1	0	← b0 OF PERMANENT HIGH LEVEL
3	1	0	0	← b4 OF PERMANENT HIGH LEVEL
4	1	1	1

FIG.29A

FLAG REGISTER 1

b7	b6	b5	b4	b3	b2	b1	b0

FIG.29B

FLAG REGISTER 2

b7	b6	b5	b4	b3	b2	b1	b0

FIG.29C

b0 OF FLAG REGISTER 1 ——
b0 OF FLAG REGISTER 2 —— FLAG STATUS
b2 OF FLAG REGISTER 2 ——

FIG.30

CHIP STRUCTURE

BLOCK NO.000
BLOCK NO.001
BLOCK NO.002
BLOCK NO.003
BLOCK NO.004
BLOCK NO.005
∫
∫
∫
BLOCK NO.511

CHIP=2MBYTE

BLOCK STRUCTURE

SECTOR NO.00
SECTOR NO.01
SECTOR NO.02
SECTOR NO.03
SECTOR NO.04
SECTOR NO.05
SECTOR NO.06
SECTOR NO.07

BLOCK=4KBYTE

SECTOR STRUCTURE

REAL DATA AREA 256BYTE	
ECC AREA FOR LONG INSTRUCTION	4BYTE
DEFECTIVE DATA FLAG	1BYTE
DEFECTIVE BLOCK FLAG	1BYTE
BLOCK ADDRESS	2BYTE
REAL DATA AREA 256BYTE	
ECC AREA	6BYTE (3+3)
FREE	2BYTE

SECTOR=528BYTE

FIG.31A

CHIP NO.00
WORK01
WORK02
WORK03
WORK04
..

CHIP NO.01
WORK01
WORK02
WORK03
WORK04
..

CHIP NO.02
WORK01
WORK02
WORK03
WORK04
..

CHIP NO.03
WORK01
WORK02
WORK03
WORK04
..

CHIP NO.04
WORK01
WORK02
WORK03
WORK04
..

FIG.31B

CHIP NO.00
000~007SEC
WORK02
WORK03
WORK04
WORK01
..

CHIP NO.01
008~015SEC
WORK02
WORK03
WORK04
WORK01
..

CHIP NO.02
016~023SEC
WORK02
WORK03
WORK04
WORK01
..

CHIP NO.03
024~031SEC
WORK02
WORK03
WORK04
WORK01
..

CHIP NO.04
032~039SEC
WORK02
WORK03
WORK04
WORK01
..

FIG.31C

CHIP NO.00	CHIP NO.01	CHIP NO.02	CHIP NO.03	CHIP NO.04
000~007SEC	008~015SEC	016~023SEC	024~031SEC	032~039SEC
120~127SEC	128~135SEC	136~143SEC	144~151SEC	152~159SEC
160~167SEC	168~175SEC	176~183SEC	184~191SEC	WORK03
WORK04	WORK04	WORK04	WORK04	WORK04
WORK01	WORK01	WORK01	WORK01	WORK01
WORK02	WORK02	WORK02	WORK02	WORK02
WORK03	WORK03	WORK03	WORK03	
..	..	..	..	..

FIG.31D

CHIP NO.00	CHIP NO.01	CHIP NO.02	CHIP NO.03	CHIP NO.04
WORK04	008~015SEC	016~023SEC	024~031SEC	032~039SEC
120~127SEC	128~135SEC	136~143SEC	144~151SEC	152~159SEC
160~167SEC	168~175SEC	176~183SEC	184~191SEC	WORK03
000~007SEC	WORK04	WORK04	WORK04	WORK04
WORK01	WORK01	WORK01	WORK01	WORK01
WORK02	WORK02	WORK02	WORK02	WORK02
WORK03	WORK03	WORK03	WORK03	
..	..	..	..	..

FIG.31E

CHIP NO.00	CHIP NO.01	CHIP NO.02	CHIP NO.03	CHIP NO.04
120~127SEC	008~015SEC	016~023SEC	024~031SEC	032~039SEC
160~167SEC	128~135SEC	136~143SEC	144~151SEC	152~159SEC
000~007SEC	168~175SEC	176~183SEC	184~191SEC	WORK01
WORK01	WORK01	WORK01	WORK01	WORK02
WORK02	WORK02	WORK02	WORK02	WORK03
WORK03	WORK03	WORK03	WORK03	WORK04
WORK04	WORK04	WORK04	WORK04	
..	..	..	..	..